CLAIM LISTING:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently amended) A tuner comprising:

   a direct digital frequency synthesizer having an output terminal for providing a digital local oscillator signal having a frequency chosen to mix a channel to a desired frequency; and

   a mixer having a first input terminal for receiving a radio frequency signal, a second input terminal coupled to the output terminal of the direct digital frequency synthesizer, and an output terminal for providing an analog output signal at a desired frequency, wherein the second input terminal of the mixer is configured to receive the digital local oscillator signal.

2. (Original) The tuner of claim 1, wherein the desired frequency of the output signal is at baseband.

3. (Original) The tuner of claim 1, wherein the radio frequency signal comprises a plurality of channels and wherein the desired frequency of the output signal is less than or equal to three channel widths.

4. (Original) The tuner of claim 1, wherein the radio frequency signal comprises a plurality of channels and wherein the desired frequency of the output signal is greater than three channel widths.

5. (Original) The tuner of claim 4, wherein the radio frequency signal represents a radio band signal.

6. (Original) The tuner of claim 5, wherein the radio band signal is an FM radio signal.

7. (Original) The tuner of claim 1, wherein the direct digital frequency synthesizer and the mixer are combined in a single integrated circuit.

8. (Original) The tuner of claim 1, wherein the mixer comprises: a transconductance amplifier

having an input terminal for receiving the radio frequency signal, and an output terminal for providing at least one current signal; and a mixing digital-to-analog converter having a first input terminal coupled to the output terminal of the transconductance amplifier, a second input terminal coupled to the output terminal of the direct digital frequency synthesizer, and an output terminal for providing the output signal at the desired frequency.

9. (Original) The tuner of claim 8, wherein the radio frequency signal, the current signal, and the output signal comprise differential signals.

10. (Original) The tuner of claim 8, wherein the transconductance amplifier comprises a plurality of current cells.

11. (Original) The tuner of claim 10, wherein the plurality of current cells is characterized as being binarily weighted.

12. (Original) The tuner of claim 10, wherein the plurality of current cells include a first plurality of current cells characterized as being binarily weighted and a second plurality of current cells characterized as being equally weighted.

13. (Original) The tuner of claim 1, wherein the direct digital frequency synthesizer further comprises an input terminal for receiving a tuning signal corresponding to a desired channel and is configured to provide the digital local oscillator signal at a frequency determined at least in part by the tuning signal.

14. (Original) The tuner of claim 10, wherein each cell comprises: a current source having first and second terminals, the current source having a size proportional to an order of the cell and generating an output current proportional to a voltage applied at the second terminal; a modulation circuit configured to modulate a voltage at the first terminal of the current source in response to a received voltage signal; and a selection circuit configured to selectively divert the output current between the first output terminal and a second output terminal in response to a bit of a digital local oscillator signal having an order corresponding to an order of the cell.

15. (Original) The tuner of claim 14, wherein the first output terminal comprises a single-ended output signal and the second output terminal comprises a reference voltage terminal.

16. (Original) The tuner of claim 14, wherein the first and second output terminals together form a differential output signal of the mixer.

17. (Original) The tuner of claim 14, further comprising:

a second current source having first and second terminals, the second current source having a size proportional to the order of the cell and generating an output current proportional to a voltage applied at the second terminal;

means for modulating a voltage at the first terminal of the second current source in response to a second received voltage signal; and

means for selectively diverting current between the second output terminal and the first output terminal respectively in response to the bit and a complement of the bit.

18. (Original) The tuner of claim 7, further comprising at least one additional receive path on the single integrated circuit, the additional receive path comprising:

a second direct digital frequency synthesizer having an output terminal for providing a digital local oscillator signal having a frequency chosen to mix a channel to a desired frequency; and a second mixer having a first input terminal for receiving a radio frequency signal, a second input terminal coupled to the output terminal of the second direct digital frequency synthesizer, and an output terminal for providing a second output signal at a desired frequency.

19. (Original) The tuner of claim 18, wherein the first mixer and the second mixer receive a radio frequency signal within the same frequency band.

20. (Original) The tuner of claim 18, wherein the first mixer and the second mixer receive a radio frequency signal in different frequency bands.

21. (Original) The tuner of claim 7, wherein the radio frequency signal represents a television signal.

22. (Original) The tuner of claim 21, further comprising a second mixer having a first input

terminal for receiving the radio frequency signal, a second input terminal, and an output terminal for providing a quadrature signal, wherein the direct digital frequency synthesizer further has a second output terminal coupled to the second input terminal of the second mixer for providing for providing a phase-shifted digital local oscillator signal.

23. (Original) The tuner of claim 22, further comprising an converter circuit configured to convert the output signals from the first and second mixers to a predetermined center frequency.

24. (Original) The tuner of claim 23, further comprising a second direct digital frequency synthesizer having a output coupled to the converter circuit.

25. (Original) The tuner of claim 7, further comprising an oscillator having a clock signal as an output, the mixer being configured to receive the clock signal and the direct digital frequency synthesizer being configured to receive the clock signal through a divider.

26. (Original) The tuner of claim 25, wherein the mixer further comprises an interpolation filter and a modulator coupled to the output of the direct digital frequency synthesizer to generate a digital M-bit signal to a switching network and the mixer further comprises transconductance circuitry configured to output M current signals to the switching network, the switching network being configured to output the output signal at the desired frequency.

27. (Original) The tuner of claim 7, wherein the radio frequency signal represents a radio band signal.

28. (Original) The tuner of claim 27, wherein the radio band signal is an FM radio signal.

29. (Previously presented) A method for tuning a signal comprising the steps of:

generating a digital local oscillator signal using a direct digital frequency synthesizer having a frequency chosen to mix a channel to a desired frequency;

receiving a radio frequency signal; and

mixing the radio frequency signal with the digital local oscillator signal to provide an analog output signal at the desired frequency.

30. (Original) The method of claim 29, wherein the desired frequency of the output signal is at baseband.

31. (Original) The method of claim 29, wherein the radio frequency signal comprises a plurality of channels and wherein the desired frequency of the output signal is less than or equal to three channel widths.

32. (Original) The method of claim 29, wherein the radio frequency signal comprises a plurality of channels and wherein the desired frequency of the output signal is greater than three channel widths.

33. (Original) The method of claim 29, wherein the generating and mixing steps are performed within a single integrated circuit.

34. (Original) The method of claim 29, wherein the mixing step comprises: converting the radio frequency signal to at least one current signal; and mixing the at least one current signal with the output from the direct digital frequency synthesizer.

35. (Original) The method of claim 34, wherein the radio frequency signal, the current signal, and the output signal comprise differential signals.

36. (Original) The method of claim 34, wherein the converting step comprises generating a plurality of current signals using a plurality of transconductor cells.

37. (Original) The method of claim 29, further comprising applying to the direct digital frequency synthesizer a tuning signal corresponding to a desired channel to be tuned.

38. (Original) The method of claim 33, further comprising generating a second digital local oscillator signal having a frequency chosen to mix a channel to a desired frequency, and mixing a radio frequency signal with the second digital local oscillator signal to provide a second output signal at the desired frequency, additional generating and mixing steps are also performed within the single integrated circuit.

39. (Original) The method of claim 38, wherein the first mixer and the second mixer receive a radio frequency signal within the same frequency band.

40. (Original) The method of claim 38, wherein the first mixer and the second mixer receive a radio frequency signal in different frequency bands.

41. (Original) The method of claim 33, wherein the radio frequency signal represents a television signal.

42. (Original) The method of claim 41, wherein the desired frequency of the output signal is at baseband and further comprising converting the output signal from baseband to a predetermined center frequency utilizing a second digital local oscillator signal.

43. (Original) The method of claim 33, further comprising providing a reference clock signal and utilizing the reference clock signal in the generating and mixing steps.

44. (Original) The method of claim 43, wherein the mixing step comprises converting the radio frequency signal to M current signals, generating an M-bit digital signal from the digital local oscillator signal, and mixing the M current signals with the M-bit digital signal to provide the output signal at the desired frequency.

45. (Original) The method of claim 33, wherein the radio frequency signal represents a radio band signal.

46. (Original) The method of claim 45, wherein the radio band signal is an FM radio signal.